Journal of Physics Condensed Matter 2002 vol.14 N50, pages 13835-13856

Photoluminescence of KZnF3:Tl+ and KMgF3:Tl+ crystals

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Abstract

The luminescence spectra of KZnF3:Tl+ and KMgF3:Tl+ crystals with a perovskite structure were investigated in the temperature range of 4.2-300 K and at optical excitation in the A absorption band (~6 eV). The spectrum of KZnF3:Tl+ at 300 K is a wide band with the maximum Emax at 5.48 eV and the width of about 0.47 eV. At 100 K the band splits into two components: An intensive one with Emax = 5.63 eV and a width of about 0.2 eV and a weak one with Emax = 4.66 eV. At 4.2 K an intensive broad band practically disappears and a narrow line accompanied by a vibration structure is observed at E = 5.725 eV. This line is assigned to a zero-phonon transition from the metastable 3Γ1u level to the ground 1Γ1g level, weakly allowed due to the hyperfine interaction and phonon-assisted mechanisms. The spectrum of KMgF3:Tl+ at 300 K is a band with the maximum at 5.78 eV and a width of about 0.3 eV. This band does not disappear at 4.2 K; its maximum shifts to higher frequencies (5.91 eV) and an intensive narrow line at 5.812 eV is observed on its background. The temperature-dependent luminescence decay was also investigated. At T = 10 K the lifetime of the slow component of luminescence is τs = 11.6 ms for KZnF3:Tl+ and τs = 14.9 ms for KMgF3:Tl+. The main features of the observed luminescence spectra are satisfactorily explained within the framework of the conventional theory, as a manifestation of the Jahn-Teller effect for the excited 6sp electron configuration of an admixture Tl+ ion, with a set of model parameters close to that used earlier to describe absorption spectra of the studied crystals.

http://dx.doi.org/10.1088/0953-8984/14/50/310